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cause of morbidity and mortality worldwide. According to the World Health Organization (WHO), an estimated 10 million people fell ill with TB in 2020, with 1.5 million succumbing to the disease [4]. TB disproportionately a ects low- and middle-income countries, where factors such as poverty, malnutrition, HIV/AIDS, and limited access to healthcare contribute to its prevalence. Furthermore, the emergence of drug-resistant TB poses a signi cant challenge to TB control e orts, requiring complex treatment regimens and straining healthcare systems.

TB is primarily transmitted through the inhalation of airborne droplets containing Mycobacterium tuberculosis. When an infected individual coughs, sneezes, or speaks, the bacteria are expelled into the air, where they can be inhaled by others. Once inhaled, the bacteria travel to the lungs, where they invade and replicate within macrophages, the body's immune cells. In some cases, the immune system is unable to contain the infection, leading to the development of active TB disease. Factors such as malnutrition, HIV infection, diabetes, and immunosuppressive medications increase the risk of progression from latent TB infection to active disease.

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TB can a ect any part of the body, but it most commonly a ects the lungs, causing pulmonary TB. Symptoms of pulmonary TB may include cough, fever, night sweats, weight loss, and hemoptysis (coughing up blood). Extra-pulmonary TB [5], which a ects organs outside the lungs, can present with a wide range of symptoms depending on the site of infection. Diagnosis of TB typically involves a combination of clinical evaluation, radiological imaging, microbiological testing (such as sputum smear microscopy and culture), and molecular techniques (such as nucleic acid ampli cation tests).

e treatment of TB relies on a combination of antimicrobial drugs, typically administered over a period of six to nine months. e most common rst-line drugs include isoniazid, rifampicin, ethambutol, and pyrazinamide. Treatment regimens for drug-susceptible TB are highly e ective when taken as prescribed. However, the emergence of drug-resistant TB strains, including multidrug-resistant TB (MDR-TB) and extensively drug-resistant TB (XDR-TB), presents a formidable challenge to TB control e orts. Management of drug-resistant TB requires prolonged treatment with second-line drugs, which are o en more toxic, less e ective, and more expensive than rst-line drugs [6].

Preventing the spread of TB requires a comprehensive approach that addresses both biomedical and social determinants of health. Key strategies include early detection and treatment of TB cases, contact tracing and screening of high-risk populations, infection control measures in. Furthermorid amplihet eg-clude ih1Dgedadglm(de))Tj0.0 almthee-Guéreas(BCG(Mliheeescribed. Howeveve 3cacyany partBCGgen